Impact of Combat Deployment and Postraumatic Stress Disorder on Newly Reported Coronary Heart Disease Among US Active Duty and Reserve Forces

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Background—The recent conflicts in Iraq and Afghanistan have exposed thousands of service members to intense stress, and as a result, many have developed posttraumatic stress disorder (PTSD). The role of military deployment experiences and PTSD in coronary heart disease (CHD) is not well defined, especially in young US service members with recent combat exposure.

Methods and Results—We conducted a prospective cohort study to investigate the relationships between wartime experiences, PTSD, and CHD. Current and former US military personnel from all service branches participating in the Millennium Cohort Study during 2001 to 2008 (n=60 025) were evaluated for newly self-reported CHD. Electronic medical record review for *International Classification of Diseases, Ninth Revision, Clinical Modification* codes for CHD was conducted among a subpopulation of active duty members (n=23 794). Logistic regression models examined the associations between combat experiences and PTSD with CHD with adjustment for established CHD risk factors. A total of 627 participants (1.0%) newly reported CHD over an average of 5.6 years of follow-up. Deployers with combat experiences had an increased odds of newly reporting CHD (odds ratio, 1.63; 95% confidence interval, 1.11–2.40) and having a diagnosis code for new-onset CHD (odds ratio, 1.93; 95% confidence interval, 1.31–2.84) compared with noncombat deployers. Screening positive for PTSD symptoms was associated with self-reported CHD before but not after adjustment for depression and anxiety and was not associated with a new diagnosis code for CHD.

Conclusions—Combat deployments are associated with new-onset CHD among young US service members and veterans. Experiences of intense stress may increase the risk for CHD over a relatively short period among young adults. (*Circulation*. 2014;129:1813-1820.)

Key Words: coronary disease ■ epidemiology ■ etiology ■ heart diseases ■ stress

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Posttraumatic stress disorder (PTSD), a condition triggered by a traumatic stressful event, has been suggested to increase the risk of coronary heart disease (CHD)[1,2] and other cardiovascular diseases.[3–5] Although stress is a contributing factor for CHD[6] and is present during combat, the role of specific deployment experiences and PTSD on the incidence of newly reported CHD is not well defined, especially among US service members soon after deployment in support of the operations in Iraq and Afghanistan.

Published prospective studies on veterans have reported positive associations between PTSD and cardiovascular diseases,[2,4,5,7] but no association between combat exposure during or before

the Vietnam conflict and CHD risk.[8] Retrospective research has indicated that individuals deployed to the 1991 Gulf War reported chest pain and cardiovascular disorders more often than non–Gulf War veterans.[9,10] However, these studies have included predominantly older veteran populations and were conducted approximately a decade or longer after wartime experiences.

Because the number of combat-exposed veterans continues to increase, with many service members returning with PTSD symptoms,[11,12] an understanding of the impact of these experiences on CHD is important given that heart disease is the leading cause of death in the United States.[13] Furthermore, most studies on CHD have used older populations with remote military experiences, and no data exist on the acute effects of wartime experiences on CHD among recently deployed service personnel. Hence, we conducted the first ongoing prospective

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study to investigate whether specific deployment experiences and PTSD symptoms are associated with newly reported CHD among a young cohort of US active duty, Reserve, and National Guard members.

Methods

Study Population and Data Sources

Participants included in this research were enrolled in the Millennium Cohort Study, a large prospective study initiated in 2001 to assess the health effects of military service, including deployment-related experiences.[14–16] Invited participants were randomly selected from US military personnel serving in October 2000. To ensure sufficient power to detect differences in smaller subgroups, this cross section of the US military was oversampled for service members with previous deployment experience to southwest Asia, Bosnia, or Kosovo; Reserve and National Guard members; and women. The methodology of the Millennium Cohort Study has been described previously.[15] Participants provided informed voluntary consent and completed a baseline survey, followed by follow-up questionnaires that were offered at ≈3-year intervals. The study was approved by the Institutional Review Board at the Naval Health Research Center and conducted in compliance with all applicable federal regulations governing the protection of human subjects (protocol NHRC.2000.0007).

Of the 209 146 participants invited to participate during 2001 to 2003, 77 047 consenting participants enrolled, 55 021 (71%) completed the first follow-up questionnaire (2004-2006), and 54 790 (71%) completed the second follow-up questionnaire (2007-2008). Compared with those who did not enroll, participants were slightly more likely to be female, older, white/non-Hispanic, officers, more educated, and serving in the Army; deployment status before enrollment was similar between participants and nonparticipants.[17]

Two analytic populations were created to assess the outcome of newly reported CHD. We used self-reported survey data (all members of the cohort) and diagnostic codes from the medical records (among active duty members). Of the 77 019 consenting eligible participants (n=28 excluded because of ineligibility) who completed the baseline questionnaire, the following were excluded from the CHD self-report population: 2065 (2.7%) who reported CHD at baseline, 13 264 (17.2%) who did not complete at least 1 follow-up questionnaire, 1191 (1.5%) missing CHD status at baseline, 422 (<1.0%) missing CHD status at follow-up, and 52 (<1.0%) who responded affirmatively to all 41 provider-diagnosed medical conditions. The total self-report population for the present analysis included 60 025 participants. For the population with medical diagnosis codes (*International Classification of Diseases, Ninth Revision* [*ICD-9-CM*]), we evaluated service members on active duty service, because this group had accessible records. Of the 77 019 consenting eligible participants, the following were excluded from the *ICD-9-CM* population: 42 161 Reserve/Guard members (56.8%), 359 (<1.0%) of whom had a CHD code before baseline; 5554 (12.9%) separated military members; 5091 (6.3%) who were missing both follow-up surveys; and 60 (<1.0%) who responded affirmatively to all provider-diagnosed medical conditions. The total *ICD-9-CM* population for the present analysis included 23 794 participants.

Survey data from the Millennium Cohort Study were used to assess PTSD symptoms, combat experiences, and health conditions and behaviors. Demographic and occupational data were obtained from the Defense Manpower Data Center, Monterey, CA, and included sex, birth year, race/ethnicity, education, marital status, military pay grade, service component, service branch, occupation, and deployments. Education and marital status were supplemented with self-reported data when missing. Medical record data for active duty participants included electronic outpatient and inpatient *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes from Department of Defense facilities and claims from non–Department of Defense facilities billed through the military insurance program, TRICARE. Outpatient and inpatient medical record data were available starting October 1998.

Outcome

Coronary Heart Disease

Newly reported CHD was defined as the self-reported absence of a doctor or other health professional diagnosis of CHD, heart attack, or angina (chest pain) at or before the baseline survey and the presence of CHD or heart attack at follow-up. Affirmative responses to "angina (chest pain)" at follow-up were not included in the definition to avoid potential misclassification of noncardiac causes of chest pain as CHD.

New-onset CHD medical diagnosis codes encompassed ischemic heart disease conditions (*ICD-9-CM* codes 410–414). Participants with a new-onset CHD diagnosis code were included if they lacked an outpatient and inpatient code for ischemic heart disease at or before the baseline survey but had an affirmative code by the latest follow-up survey assessment. To ensure adequate time for entry of codes into the databases, we investigated electronic health records for 90 days after the follow-up questionnaire submission date. Previous validity studies have found moderate to substantial agreement between self-report and medical records for CHD and myocardial infarction, with a sensitivity of 62% and specificity of 99% for incident CHD.[18,19] In the present study, self-report and provider diagnosis code agreement was fair (κ=0.28; 95% confidence interval [CI], 0.22–0.34), with a sensitivity of 43% and specificity of 99%.

Exposures of Interest

Deployment

Deployment in support of the operations in Iraq and Afghanistan was based on in- and out-of-theater dates recorded in official military records. Among deployers, combat experience was assessed on follow-up surveys through self-report of personally witnessing or being exposed to ≥1 of the following over the past 3 years: A person's death caused by war or disaster, physical abuse, dead or decomposing bodies, maimed soldiers or civilians, and prisoners of war or refugees.[12]

Posttraumatic Stress Disorder

PTSD symptoms were assessed at baseline and follow-up by use of survey responses from the PTSD Checklist, Civilian Version (PCL-C). PTSD was identified in participants who reported a moderate or higher level of at least 1 intrusion, 3 avoidance, and 2 hyperarousal symptoms, with a PCL-C score of ≥50 (specific criteria).[20] The validity of this measure has been studied among both civilian and military populations[11,21,22] and has demonstrated good internal consistency in this cohort.[23]

Covariates

Covariates were assessed at baseline and included body mass index, which was calculated from self-reported height and weight as weight (kg)/height (m)[2]. Self-reported smoking status was categorized as never, past, or current by use of questions that assessed lifetime smoking of ≥100 cigarettes (5 packs), a successful attempt to quit smoking, and cigarette use in the past year. Self-reported alcohol use in the past year was categorized as none/low, moderate, or high consumption based on the question, "In the past year, on those days that you drank alcoholic beverages, on average, how many drinks did you have?"[24] Moderate drinkers were categorized as consuming 1 (female) or 1 to 2 (male) drinks on days they drank alcohol, while high consumption was defined as >1 (female) or >2 (male) drinks; those with lower amounts were categorized as none/low. Diabetes mellitus and hypertension were identified through self-report of a provider's diagnosis. Depression and anxiety symptoms were captured through the Patient Health Questionnaire,[25] embedded in the Millennium Cohort questionnaire. Depression symptoms were time updated and assessed with the baseline and follow-up survey responses, whereas anxiety symptoms were included from the baseline survey only.

Self-reported physical activity and strength-training classifications were categorized as active or inactive based on recommendations made by the American College of Sports Medicine and the American Heart Association.[26] These 2 variables were assessed at the first follow-up survey, because these questions were first available on the survey in 2004 to 2006.

Statistical Analyses

Descriptive and bivariate analyses were used to evaluate the unadjusted associations between newly reported CHD and deployment experiences, PTSD, and other covariates. The generalized estimating equations method was used to prospectively assess the associations between the exposures of interest (ie, deployment experiences and PTSD) with the outcome of newly reported CHD, adjusted for covariates and time between baseline and follow-up. The exposures of interest were assessed at the baseline and follow-up surveys, and their associations with the subsequent development of newly reported CHD were evaluated with the first or second follow-up surveys or both. The modeling procedures used in the present study assessed exposures before the outcome; outcomes that predated the exposures of interest did not contribute to the associations. Three separate models, adjusted for different combinations of variables, were conducted: (1) Adjustment for age, sex, and race; (2) adjustment for all covariates except depression and anxiety; and (3) adjustment for all covariates, including depression and anxiety. Deployment, PTSD, and depression were measured longitudinally with the baseline and follow-up surveys and were assessed before the first report of CHD. Anxiety was assessed only at baseline, because this condition may have similar symptoms as PTSD. We used multiple imputation techniques to ensure the most robust study population by imputing data for all missing covariates including deployment experiences and PTSD. In addition to the multiple imputation models, we repeated the analyses using only participants with complete data and found similar findings. A subanalysis that used the outcome of a new-onset CHD diagnosis code was conducted in a subset of participants who remained on active duty throughout follow-up and for whom all electronic healthcare records were available. For all models, multicollinearity was defined by a variance inflation factor of ≥ 4. The potential interaction of PTSD and sex was tested at $P \leq 0.10$. Confounding factors were evaluated and retained in the adjusted model if they changed the measure of association between deployment or PTSD and CHD by >10%. Statistical significance for all variables within the models was a priori defined as $P<0.05$. All data analyses were conducted with SAS, version 9.2 (SAS Institute, Inc, Cary, NC).

Results

A total of 627 of the 60 025 participants (1.0%) newly self-reported CHD over a mean of 5.6 years between baseline and the most recent follow-up. The mean age of the participants at baseline was 34.4 years, whereas the mean age of those with newly reported CHD was 43.1 years. At baseline, service members with newly reported CHD were proportionally more likely to be male, older, married, in the Reserves/National Guard or Army, obese, a smoker, a heavy drinker, and inactive with regard to physical activity and strength training, as well as to have diabetes mellitus, hypertension, and depression (Table I in the online-only Data Supplement).

Among the self-reported study population, 900 had deployed with combat experiences before the baseline assessment, 6446 between baseline and the first follow-up assessment (or report of CHD if indicated), and 7024 between the first and second follow-up assessments (or report of CHD if indicated). Deployments without combat experiences occurred among 964, 7224, and 6536 participants in the respective time frames. A total of 1193 participants screened positive for PTSD at baseline, 1304 at the first follow-up, and 1826 at the second follow-up. The mean time between the baseline and first follow-up survey was 2.7 years, whereas the mean time between the 2 follow-up surveys was 2.9 years. Characteristics by deployment experiences and PTSD symptoms are shown in Table 1.

In age-, sex-, and race-adjusted models, combat deployers had higher odds of newly self-reported CHD (adjusted odds ratio [OR], 1.81; 95% CI, 1.25–1.64). In the multivariable longitudinal analysis adjusted for all covariates, combat deployers remained at significantly higher odds of newly reporting CHD (adjusted OR, 1.63; 95% CI, 1.11–2.40) compared with noncombat deployers (Table 2). No significant associations were found among nondeployers compared with noncombat deployers. In the final adjusted model, other characteristics associated with newly reported CHD included being male, older, less educated, overweight or obese, a current or past smoker and having hypertension (Table II in the online-only Data Supplement). Among those who were deployed, the number of cumulative days of deployment was also evaluated, but no significant association with self-reported CHD was found (Table III in the online-only Data Supplement).

Screening positive for PTSD was significantly associated with newly self-reported CHD in the age-, sex-, and race-adjusted model (OR, 2.25; 095% CI, 1.49–3.39) and in the multivariable model without adjustment for depression and anxiety (adjusted OR, 1.66; 95% CI, 1.10–2.50; Table 2). When depression and anxiety were included in the adjusted model, screening positive for PTSD symptoms was no longer associated with newly reported CHD (adjusted OR, 1.27; 95% CI, 0.76–2.12; Table 2). A moderately strong correlation between depression and PTSD ($r=0.46$) was noted in the present study; for instance, among those with PTSD, 57% also met criteria for depression, and 38% met those for anxiety. PTSD was also examined by use of a continuous scale among deployers, but no relationship between the PCL-C score and CHD was found (Table III in the online-only Data Supplement). Multicollinearity was assessed in all multivariable models, and there was no variable with a variance inflation level ≥ 4; an interaction term between PTSD and sex was not significant at the $P \leq 0.10$ level.

In a subanalysis of 23 794 active-duty participants with *ICD-9-CM* codes, 342 (1.4%) had new-onset CHD (Table I in the online-only Data Supplement). After adjustment for all covariates, deployers who reported combat experiences had nearly twice the odds of having a diagnosis code for new-onset CHD (adjusted OR, 1.93; 95% CI, 1.31–2.84) as deployers without combat exposure. Active duty participants with a diagnosis code for new-onset CHD were more likely to be older, married, obese, and a current smoker and to report none/low drinking versus high consumption, as well as hypertension or depression (Table II in the online-only Data Supplement). PTSD symptoms were not associated with newly diagnosed CHD by medical codes in any multivariable model with or without adjustment for depression and anxiety (Table 3).

Discussion

Combat deployment, in addition to other established risk factors for heart disease, was associated with newly reported CHD and CHD defined by *ICD-9-CM* diagnosis codes. Screening positive for PTSD was associated with self-reported CHD before but not after adjustment for depression and anxiety, and was not associated with CHD by diagnostic codes. These findings suggest that young military personnel who experienced combat during the recent conflicts may have a heightened risk for the development of CHD. The present study highlights the potential impact of acutely stressful experiences on the development of CHD over a relatively short time period in young adults.

Table 1. Characteristics of Millennium Cohort Participants by Deployment and PTSD Status (2001–2008)

Baseline Characteristics	Deployment Experiences			PTSD, Specific Criteria	
	Nondeployed (n=37 143)	Deployed, No Combat (n=10 602)	Deployed, Combat (n=12 280)	No (n=56 694)	Yes (n=3331)
Newly reported CHD*†‡					
No disease	36 666 (98.7)	10 530 (99.3)	12 202 (99.4)	56 134 (99.0)	3264 (98.0)
Disease	477 (1.3)	72 (0.7)	78 (0.6)	560 (1.0)	67 (2.0)
Sex†‡					
Male	25 301 (68.1)	8253 (77.8)	10 360 (84.4)	41 728 (73.6)	2186 (65.6)
Female	11 842 (31.9)	2349 (22.2)	1920 (15.6)	14 966 (26.4)	1145 (34.4)
Birth year†‡					
Before 1960	10 321 (27.8)	1757 (16.6)	1701 (13.9)	13 137 (23.2)	642 (19.3)
1960–1969	14 408 (38.8)	4527 (42.7)	5051 (41.1)	22 794 (40.2)	1192 (35.8)
1970–1979	10 882 (29.3)	3791 (35.8)	4866 (39.6)	18 302 (32.3)	1237 (37.1)
1980 or later	1532 (4.1)	527 (5.0)	662 (5.4)	2461 (4.3)	260 (7.8)
Race/ethnicity†‡					
Non-Hispanic white	26 363 (71.0)	7452 (70.3)	8410 (68.5)	40 092 (70.7)	2133 (64.0)
Non-Hispanic black	4941 (13.3)	1424 (13.4)	1251 (10.2)	7059 (12.5)	557 (16.7)
Other	5839 (15.7)	1726 (16.3)	2619 (21.3)	9543 (16.8)	641 (19.2)
Education†‡					
Some college or less	26 132 (70.4)	7929 (74.8)	8821 (71.9)	40 036 (70.6)	2849 (85.5)
Bachelor's degree or higher	11 011 (29.6)	2673 (25.2)	3456 (28.1)	16 658 (29.4)	482 (14.5)
Marital status†‡					
Not married	12 718 (34.3)	3718 (35.1)	4353 (35.5)	19 382 (34.2)	1407 (42.2)
Married	24 425 (65.8)	6884 (64.9)	7927 (64.6)	37 312 (65.8)	1924 (57.8)
Military pay grade†‡					
Enlisted	27 583 (74.3)	8100 (76.4)	8837 (72.0)	41 571 (73.3)	2949 (88.5)
Officer	9560 (25.7)	2502 (23.6)	3443 (28.0)	15 123 (26.7)	382 (11.5)
Service component†					
Reserve/Guard	17 503 (47.1)	3875 (36.6)	4688 (38.2)	24 571 (43.3)	1495 (44.9)
Active duty	19 640 (52.9)	6727 (63.5)	7592 (61.8)	32 123 (56.7)	1836 (55.1)
Service branch†‡					
Army	16 990 (45.7)	3373 (31.8)	7641 (62.2)	25 821 (45.5)	2183 (65.5)
Air Force	10 751 (28.9)	4706 (44.4)	2677 (21.8)	17 631 (31.1)	503 (15.1)
Marine Corps	1676 (4.5)	348 (3.3)	738 (6.0)	2608 (4.6)	154 (4.6)
Navy/Coast Guard	7726 (20.8)	2175 (20.5)	1224 (10.0)	10 634 (18.8)	491 (14.7)
Occupation†‡					
Combat specialist	6583 (17.7)	2039 (19.2)	3605 (29.4)	11 618 (20.5)	609 (18.3)
Healthcare specialist	2885 (13.2)	420 (4.0)	1251 (10.2)	6233 (11.0)	323 (9.7)
Other	25 675 (69.1)	8143 (76.8)	7424 (60.5)	38 843 (68.5)	2399 (72.0)
Body mass index,†‡ kg/m²					
Normal/underweight (<25)	13 968 (37.6)	3903 (36.8)	4261 (34.7)	20 965 (37.0)	1167 (35.0)
Overweight (25 to <30)	18 871 (50.8)	5728 (54.0)	6843 (55.7)	29 801 (52.6)	1641 (49.3)
Obese (≥30)	4304 (11.6)	971 (9.2)	1176 (9.6)	5928 (10.5)	523 (15.7)
Smoking status†‡					
Nonsmoker	21 604 (58.2)	6484 (61.2)	7077 (57.6)	33 636 (59.3)	1529 (45.9)
Past smoker	9604 (25.9)	2462 (23.2)	2977 (24.2)	14 159 (25.0)	884 (26.5)
Current smoker	5935 (16.0)	1656 (15.6)	2226 (18.1)	8899 (15.7)	918 (27.6)
Alcohol use†‡					
Low/none	11 012 (29.7)	2698 (25.5)	2663 (21.7)	15 421 (27.2)	952 (28.6)
Moderate	11 485 (30.9)	3373 (31.8)	3993 (32.5)	18 213 (32.1)	638 (19.2)
					(*Continued*)

Table 1.   Continued

Baseline Characteristics	Deployment Experiences			PTSD, Specific Criteria	
	Nondeployed (n=37 143)	Deployed, No Combat (n=10 602)	Deployed, Combat (n=12 280)	No (n=56 694)	Yes (n=3331)
Heavy	14 646 (39.4)	4531 (42.7)	5624 (45.8)	23 060 (40.7)	1741 (52.3)
Physical activity†‡					
Inactive	16 051 (43.2)	3633 (34.3)	3682 (30.0)	21 702 (38.3)	1664 (49.9)
Active	21 092 (56.8)	6969 (65.7)	8598 (70.0)	34 992 (61.7)	1667 (50.1)
Strength training†‡					
Inactive	23 453 (63.1)	5762 (54.4)	5463 (44.5)	32 542 (57.4)	2136 (64.1)
Active	13 690 (36.9)	4840 (45.7)	6817 (55.5)	24 152 (42.6)	1195 (35.9)
Diabetes mellitus†‡					
No	36 721 (98.9)	10 549 (99.5)	12 238 (99.7)	56 222 (99.2)	3286 (98.7)
Yes	422 (1.1)	53 (0.5)	42 (0.3)	472 (0.8)	45 (1.4)
Hypertension†‡					
No	33 213 (89.4)	9825 (92.7)	11 411 (92.9)	51 561 (91.0)	2888 (86.7)
Yes	3930 (10.6)	777 (7.3)	869 (7.1)	5133 (9.1)	443 (13.3)
Depression†‡					
No	35 959 (96.8)	10 421 (98.3)	11 983 (97.6)	55 896 (98.6)	2467 (74.1)
Yes	1184 (3.2)	181 (1.7)	297 (2.4)	798 (1.4)	864 (25.9)
Anxiety†‡					
No	36 407 (98.0)	10 499 (99.0)	12 074 (98.3)	56 229 (99.2)	2751 (82.6)
Yes	736 (2.0)	103 (1.0)	206 (1.7)	465 (0.8)	580 (17.4)

Values are n (%). Percentages may not sum to 100 because of rounding. Table shows data for the self-reported CHD population (n=60 025). CHD indicates coronary heart disease; and PTSD, posttraumatic stress disorder.

*Newly reported CHD was considered present if the participant was free of disease at baseline and reported either healthcare professional–diagnosed CHD or heart attack at follow-up.

†Covariate associated with deployment at $P<0.05$ using χ^2 tests.

‡Covariate associated with PTSD at $P<0.05$ using χ^2 tests.

Similar to previous studies that reported adverse health outcomes among combat deployers,[12,27–29] combat experiences in the present study were positively associated with new-onset CHD by both self-report and diagnosis codes. Although combat deployment was not associated with CHD in the univariate model (Table I in the online-only Data Supplement), after adjustment for age and other relevant variables, a significant association was consistently noted in all models. Although military personnel are encumbered with unique occupational strain from deployment, exposure to combat appears to be a more profound stressor associated with mental and physical conditions than deployment alone or the number of cumulative days deployed.

The mechanisms by which combat deployment results in CHD are currently unknown but may be related to intense job-related stressors. Stress is believed to arouse sympathoadrenal activity, which may lead to the development of coronary atherosclerosis by invoking low-grade systemic proinflammation, arterial intimal injury, and plaque rupture.[3,4] Long-term stress may result in elevations in blood pressure and heart rate, with resultant adverse effects on the heart. Intense, frequent stress responses may also increase platelet aggregation and coronary vasoconstriction, leading to cardiovascular events, although results have varied, and the duration of the stress response may be more relevant to the development of disease.[30–33] A large study in the general population recently demonstrated that job strain was a risk factor for CHD among all age groups and socioeconomic strata after adjustment for conventional risk factors.[34]

Prior studies have suggested that combat exposure has an indirect effect on physical health outcomes mediated through PTSD, with PTSD having a direct effect.[2,35,36] The present study suggests that the effect of combat on CHD may occur independent of PTSD or the other variables in our adjusted models (eg, smoking, alcohol use, obesity), because their inclusion did not remove the effect of combat. It is noteworthy that the magnitude of the associations between combat experiences and CHD was attenuated when PTSD and other covariates were added to the models, which suggests that these factors could be part of the causal pathway (eg, PTSD or covariates such as depression may play a role in the association of combat deployment and CHD). Further study on the relationships between combat, PTSD, and CHD are warranted, particularly because prior studies in older populations have found a modest relationship between PTSD and CHD.[1,2,36,37] Furthermore, it is difficult to disentangle the effects of anxiety, depression, and PTSD, because these 3 conditions have common features.

The present study is unique in that it evaluated the acute effects of PTSD on newly reported CHD. Although we found that PTSD symptoms were associated with self-reported CHD, the findings were no longer significant after adjustment for depression and anxiety and were not present in models that

Table 2. Adjusted Odds of Newly Self-Reported Coronary Heart Disease in the Millennium Cohort Study (2001–2008): Deployment Status and PTSD

Characteristic	Age, Sex, and Race Adjusted	All Covariates Except Anxiety and Depression*	All Covariates†
Deployment experiences			
Deployed, no combat	1.00	1.00	1.00
Nondeployed	1.06 (0.68–1.66)	1.01 (0.64–1.58)	1.01 (0.64–1.58)
Deployed, combat	1.81 (1.25–2.64)	1.64 (1.11–2.41)	1.63 (1.11–2.40)
PTSD, specific criteria	2.25 (1.49–3.39)	1.66 (1.10–2.50)	1.27 (0.76–2.12)

Values are odds ratio (95% confidence interval). PTSD indicates posttraumatic stress disorder.

*Models adjusted for both primary exposures (deployment experiences and PTSD) and the additional covariates, including sex, birth year, race, education, marital status, pay grade, component and service branch, body mass index, smoking, drinking, physical and strength activity, time between baseline and follow-up surveys, diabetes mellitus, and hypertension.

†Models adjusted for both primary exposures (deployment experiences and PTSD) and the additional covariates, including sex, birth year, race, education, marital status, pay grade, component and service branch, body mass index, smoking, drinking, physical and strength activity, time between baseline and follow-up surveys, diabetes mellitus, hypertension, anxiety, and depression.

Table 3. Adjusted Odds of New Diagnostic Code for Coronary Heart Disease in the Millennium Cohort Study (2001–2008): Deployment Status and PTSD

Characteristic	Age, Sex, and Race Adjusted	All Covariates Except Anxiety and Depression*	All Covariates†
Deployment experiences			
Deployed, no combat	1.00	1.00	1.00
Nondeployed	1.29 (0.82–2.03)	1.30 (0.82–2.07)	1.30 (0.81–2.07)
Deployed, combat	2.03 (1.38–2.98)	1.93 (1.31–2.85)	1.93 (1.31–2.84)
PTSD, specific criteria	0.78 (0.29–2.15)	0.62 (0.22–1.72)	0.49 (0.16–1.53)

Values are odds ratio (95% confidence interval). PTSD indicates posttraumatic stress disorder.

*Models adjusted for both primary exposures (deployment experiences and PTSD) and the additional covariates including sex, birth year, race, education, marital status, pay grade, component and service branch, body mass index, smoking, drinking, physical and strength activity, time between baseline and follow-up surveys, diabetes mellitus, and hypertension.

†Models adjusted for both primary exposures (deployment experiences and PTSD) and the additional covariates including sex, birth year, race, education, marital status, pay grade, component and service branch, body mass index, smoking, drinking, physical and strength activity, time between baseline and follow-up surveys, diabetes mellitus, hypertension, anxiety, and depression.

used medical diagnostic codes. Of note, the lack of an association when the medical records were used may have been influenced by reduced power as a result of the smaller study population and potential underdiagnosis of CHD in the medical records. Other studies that found an association between PTSD and CHD were based on older cohorts with more remote military experiences and persistent PTSD. Because many of the pathways hypothesized to link PTSD and CHD are a result of cumulative effects of emotional dysregulation, these may have not been seen in the present study because of the relatively short follow-up period. Furthermore, because PTSD is characterized by the recurrence of symptoms of the acute stress exposure, longer follow-up and additional analyses are warranted to detect potential associations between persistent PTSD symptoms and CHD over time.

In line with established major risk factors of heart disease, such as male sex, older age, smoking, obesity, and hypertension,[6] the present study found these characteristics to be positively associated with newly reported CHD. Increased odds of CHD in these groups were found, despite our population being younger than other studies of veteran populations.[2,5]

Overall, new-onset CHD was uncommon (1.0%) among young US military service members and veterans during the study period. Compared with a study of autopsy-based coronary atherosclerosis in US service members who died of combat or unintentional injuries, the present study found a lower prevalence of CHD, but our questionnaire-based case definition required clinical symptoms that typically occur later in the course of atherosclerotic disease.[38] The rates of CHD in the present study were overall similar to that reported among young persons (12.9/1000 men and 2.2/1000 women over 10 years) in the general US population.[39]

There were several limitations to the present study. Although we adjusted for multiple risk factors for CHD,[6] data for serum cholesterol, diet, and hereditary factors other than race/ethnicity were not available. In addition, misclassification of covariates and potential residual confounding may have occurred given the self-reported nature of some covariates (eg, weight) and lack of quantitative measurements (eg, blood pressure). The follow-up period may have been too short for the development of clinically symptomatic CHD in this younger study population, resulting in small numbers; future follow-up of this cohort is recommended. Missing outcome data may have resulted in differential classification. Furthermore, underreporting or overreporting of the outcome may have occurred from the use of self-reported data to identify the presence of CHD, and hence, these data were validated with medical diagnosis codes among active duty participants who had not separated from the military. Only participants on active duty status throughout the entire study period were included in the subanalysis, because Reserve/National Guard participants may not have equal access to the Department of Defense healthcare system and we were unable to capture clinical care codes generated by medical encounters outside the Department of Defense system.

With regard to mental health conditions, we relied on self-reported symptomatic characteristics, which may be more valid than medical records because participants may be more willing to report these symptoms in a confidential manner that shields them from social stigma or negative career impact. For purposes of this research, PTSD diagnosis was established by use of a self-report measure; however, the PCL-C has established criterion validity with the Clinician-Administered PTSD Scale, the "gold standard" for assessing and diagnosing PTSD.[40] The study's results may not be representative of older

US veterans, because this cohort is predominantly composed of younger members who have served or are currently serving in the US military. Finally, survey responders had slightly different characteristics than nonresponders[17]; however, previous investigations suggest the cohort provides an overall good representation of military personnel whose responses are not influenced by poor health status.[15,23,41–47]

The present study had several strengths, including the prospective nature of the data collection, which allowed for the assessment of both combat experiences and PTSD symptoms before CHD. Incidence and estimated risks were also assessed given the prospective study design. All branches and components of the armed forces were represented across the nation and in overseas locations. The inclusion of Reserve and National Guard members is of particular significance because they are often understudied because they do not have access to the military healthcare system unless they are on active duty. Finally, given the comprehensive nature of the Millennium Cohort questionnaire, it was possible to evaluate several potential confounders and risk factors for CHD.

In summary, combat experiences during deployment may be associated with new-onset CHD among US service members and veterans. An association was found between screening positive for PTSD and new-onset self-reported CHD, but this was no longer noted after adjustment for depression and anxiety. Exposure to stressful events such as combat may play an important role in the development of CHD in a young, otherwise healthy population of US service members. Continued longitudinal research is recommended to assess the long-term burden of the recent Iraq and Afghanistan conflicts on CHD.

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References

1. Kubzansky LD, Koenen KC, Jones C, Eaton WW. A prospective study of posttraumatic stress disorder symptoms and coronary heart disease in women. *Health Psychol*. 2009;28:125–130.
2. Kubzansky LD, Koenen KC, Spiro A 3rd, Vokonas PS, Sparrow D. Prospective study of posttraumatic stress disorder symptoms and coronary heart disease in the Normative Aging Study. *Arch Gen Psychiatry*. 2007;64:109–116.
3. Dedert EA, Calhoun PS, Watkins LL, Sherwood A, Beckham JC. Posttraumatic stress disorder, cardiovascular, and metabolic disease: a review of the evidence. *Ann Behav Med*. 2010;39:61–78.
4. Boscarino JA. A prospective study of PTSD and early-age heart disease mortality among Vietnam veterans: implications for surveillance and prevention. *Psychosom Med*. 2008;70:668–676.
5. Ahmadi N, Hajsadeghi F, Mirshkarlo HB, Budoff M, Yehuda R, Ebrahimi R. Post-traumatic stress disorder, coronary atherosclerosis, and mortality. *Am J Cardiol*. 2011;108:29–33.
6. Roger VL, Go AS, Lloyd-Jones DM, Benjamin EJ, Berry JD, Borden WB, Bravata DM, Dai S, Ford ES, Fox CS, Fullerton HJ, Gillespie C, Hailpern SM, Heit JA, Howard VJ, Kissela BM, Kittner SJ, Lackland DT, Lichtman JH, Lisabeth LD, Makuc DM, Marcus GM, Marelli A, Matchar DB, Moy CS, Mozaffarian D, Mussolino ME, Nichol G, Paynter NP, Soliman EZ, Sorlie PD, Sotoodehnia N, Turan TN, Virani SS, Wong ND, Woo D, Turner MB; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics–2012 update: a report from the American Heart Association. *Circulation*. 2012;125:e2–e220.
7. Vaccarino V, Goldberg J, Rooks C, Shah AJ, Veledar E, Faber TL, Votaw JR, Forsberg CW, Bremner JD. Post-traumatic stress disorder and incidence of coronary heart disease: a twin study. *J Am Coll Cardiol*. 2013;62:970–978.
8. Johnson AM R, KM, Elder GH Jr, Chambless LE, Kaufman JS, Heiss G. Military combat and risk of coronary heart disease and ischemic stroke in aging men: the Atherosclerosis Risk in Communities (ARIC) study. *Ann Epidemiol*. 2010;20:143–150.
9. Gray GC, Reed RJ, Kaiser KS, Smith TC, Gastañaga VM. Self-reported symptoms and medical conditions among 11,868 Gulf War-era veterans: the Seabee Health Study. *Am J Epidemiol*. 2002;155:1033–1044.
10. Simmons R, Maconochie N, Doyle P. Self-reported ill health in male UK Gulf War veterans: a retrospective cohort study. *BMC Public Health*. 2004;4:27.
11. Hoge CW, Castro CA, Messer SC, McGurk D, Cotting DI, Koffman RL. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med*. 2004;351:13–22.
12. Smith TC, Ryan MA, Wingard DL, Slymen DJ, Sallis JF, Kritz-Silverstein D; Millennium Cohort Study Team. New onset and persistent symptoms of post-traumatic stress disorder self reported after deployment and combat exposures: prospective population based US military cohort study. *BMJ*. 2008;336:366–371.
13. Xu JQ, Kochanek KD, Murphy SL, Tejada-Vera B. Deaths: final data for 2007. *National Vital Statistics Reports*. Vol. 58, No. 59. Hyattsville, MD: National Center for Health Statistics; 2010.
14. Ryan MA, Amoroso P, Boyko EJ, Gackstetter GD, Hooper TI, Riddle JR; Millennium Cohort Study Group. The Millennium Cohort Study: a 21-year prospective cohort study of 140,000 military personnel. *Mil Med*. 2002; 167:483–488.
15. Ryan MA, Smith TC, Smith B, Amoroso P, Boyko EJ, Gray GC, Gackstetter GD, Riddle JR, Wells TS, Gumbs G, Corbeil TE, Hooper TI. Millennium Cohort: enrollment begins a 21-year contribution to understanding the impact of military service. *J Clin Epidemiol*. 2007;60:181–191.
16. Smith TC; Millennium Cohort Study Team. The US Department of Defense Millennium Cohort Study: career span and beyond longitudinal follow-up. *J Occup Environ Med*. 2009;51:1193–1201.
17. Hooper TI, Gackstetter GD, Leardmann CA, Boyko EJ, Pearse LA, Smith B, Amoroso PJ, Smith TC; Millennium Cohort Study Team. Early mortality experience in a large military cohort and a comparison of mortality data sources. *Popul Health Metr*. 2010;8:15.
18. Oksanen T, Kivimäki M, Pentti J, Virtanen M, Klaukka T, Vahtera J. Self-report as an indicator of incident disease. *Ann Epidemiol*. 2010;20:547–554.
19. Okura Y, Urban LH, Mahoney DW, Jacobsen SJ, Rodeheffer RJ. Agreement between self-report questionnaires and medical record data

was substantial for diabetes, hypertension, myocardial infarction and stroke but not for heart failure. *J Clin Epidemiol*. 2004;57:1096–1103.

20. Spitzer RL, Williams JB, Kroenke K, Linzer M, deGruy FV 3rd, Hahn SR, Brody D, Johnson JG. Utility of a new procedure for diagnosing mental disorders in primary care: the PRIME-MD 1000 study. *JAMA*. 1994;272:1749–1756.

21. Kok BC, Herrell RK, Thomas JL, Hoge CW. Posttraumatic stress disorder associated with combat service in Iraq or Afghanistan: reconciling prevalence differences between studies. *J Nerv Ment Dis*. 2012;200:444–450.

22. Terhakopian A, Sinaii N, Engel CC, Schnurr PP, Hoge CW. Estimating population prevalence of posttraumatic stress disorder: an example using the PTSD checklist. *J Trauma Stress*. 2008;21:290–300.

23. Smith TC, Smith B, Jacobson IG, Corbeil TE, Ryan MA. Reliability of standard health assessment instruments in a large, population-based cohort study. *Ann Epidemiol*. 2007;17:525–532.

24. American Heart Association Nutrition Committee, Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, Franklin B, Kris-Etherton P, Harris WS, Howard B, Karanja N, Lefevre M, Rudel L, Sacks F, Van Horn L, Winston M, Wylie-Rosett J. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation*. 2006;114:82–96.

25. Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version of PRIME-MD: the PHQ Primary Care Study. *JAMA*. 1999; 282:1737–1744.

26. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, Nieman DC, Swain DP; American College of Sports Medicine. American College of Sports Medicine position stand: quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc*. 2011;43:1334–1359.

27. Jankosky CJ, Hooper TI, Granado NS, Scher A, Gackstetter GD, Boyko EJ, Smith TC; Millennium Cohort Study Team. Headache disorders in the millennium cohort: epidemiology and relations with combat deployment. *Headache*. 2011;51:1098–1111.

28. Granado NS, Smith TC, Swanson GM, Harris RB, Shahar E, Smith B, Boyko EJ, Wells TS, Ryan MA; Millennium Cohort Study Team. Newly reported hypertension after military combat deployment in a large population-based study. *Hypertension*. 2009;54:966–973.

29. Wells TS, LeardMann CA, Fortuna SO, Smith B, Smith TC, Ryan MA, Boyko EJ, Blazer D; Millennium Cohort Study Team. A prospective study of depression following combat deployment in support of the wars in Iraq and Afghanistan. *Am J Public Health*. 2010;100:90–99.

30. Pieper S, Brosschot JF. Prolonged stress-related cardiovascular activation: is there any? *Ann Behav Med*. 2005;30:91–103.

31. Tofler GH, Muller JE. Triggering of acute cardiovascular disease and potential preventive strategies. *Circulation*. 2006;114:1863–1872.

32. Meisel SR, Kutz I, Dayan KI, Pauzner H, Chetboun I, Arbel Y, David D. Effect of Iraqi missile war on incidence of acute myocardial infarction and sudden death in Israeli civilians. *Lancet*. 1991;338:660–661.

33. Holman EA, Silver RC, Poulin M, Andersen J, Gil-Rivas V, McIntosh DN. Terrorism, acute stress, and cardiovascular health: a 3-year national study following the September 11th attacks. *Arch Gen Psychiatry*. 2008;65:73–80.

34. Kivimäki M, Nyberg ST, Batty GD, Fransson EI, Heikkilä K, Alfredsson L, Bjorner JB, Borritz M, Burr H, Casini A, Clays E, De Bacquer D, Dragano N, Ferrie JE, Geuskens GA, Goldberg M, Hamer M, Hooftman WE, Houtman IL, Joensuu M, Jokela M, Kittel F, Knutsson A, Koskenvuo M, Koskinen A, Kouvonen A, Kumari M, Madsen IE, Marmot MG, Nielsen ML, Nordin M, Oksanen T, Pentti J, Rugulies R, Salo P, Siegrist J, Singh-Manoux A, Suominen SB, Väänänen A, Vahtera J, Virtanen M, Westerholm PJ, Westerlund H, Zins M, Steptoe A, Theorell T; IPD-Work Consortium. Job strain as a risk factor for coronary heart disease: a collaborative meta-analysis of individual participant data. *Lancet*. 2012;380:1491–1497.

35. Schnurr PP, Spiro A 3rd. Combat exposure, posttraumatic stress disorder symptoms, and health behaviors as predictors of self-reported physical health in older veterans. *J Nerv Ment Dis*. 1999;187:353–359.

36. Kang HK, Bullman TA, Taylor JW. Risk of selected cardiovascular diseases and posttraumatic stress disorder among former World War II prisoners of war. *Ann Epidemiol*. 2006;16:381–386.

37. Boscarino JA, Chang J. Electrocardiogram abnormalities among men with stress-related psychiatric disorders: implications for coronary heart disease and clinical research. *Ann Behav Med*. 1999;21:227–234.

38. Webber BJ, Seguin PG, Burnett DG, Clark LL, Otto JL. Prevalence of and risk factors for autopsy-determined atherosclerosis among US service members, 2001-2011. *JAMA*. 2012;308:2577–2583.

39. Kannel WB, Abbott RD. Incidence and prognosis of unrecognized myocardial infarction: an update on the Framingham study. *N Engl J Med*. 1984;311:1144–1147.

40. Keen SM, Kutter CJ, Niles BL, Krinsley KE. Psychometric properties of PTSD Checklist in sample of male veterans. *J Rehabil Res Dev*. 2008;45:465–474.

41. Riddle JR, Smith TC, Smith B, Corbeil TE, Engel CC, Wells TS, Hoge CW, Adkins J, Zamorski M, Blazer D; Millennium Cohort Study Team. Millennium Cohort: the 2001-2003 baseline prevalence of mental disorders in the U.S. military. *J Clin Epidemiol*. 2007;60:192–201.

42. Smith B, Wingard DL, Ryan MA, Macera CA, Patterson TL, Slymen DJ. U.S. military deployment during 2001–2006: comparison of subjective and objective data sources in a large prospective health study. *Ann Epidemiol*. 2007;17:976–982.

43. Smith B, Smith TC, Gray GC, Ryan MA; Millennium Cohort Study Team. When epidemiology meets the Internet: Web-based surveys in the Millennium Cohort Study. *Am J Epidemiol*. 2007;166:1345–1354.

44. LeardMann CA, Smith B, Smith TC, Wells TS, Ryan MA; Millennium Cohort Study Team. Smallpox vaccination: comparison of self-reported and electronic vaccine records in the millennium cohort study. *Hum Vaccin*. 2007;3:245–251.

45. Smith TC, Jacobson IG, Smith B, Hooper TI, Ryan MA; Millennium Cohort Study Team. The occupational role of women in military service: validation of occupation and prevalence of exposures in the Millennium Cohort Study. *Int J Environ Health Res*. 2007;17:271–284.

46. Chretien JP, Chu LK, Smith TC, Smith B, Ryan MA; Millennium Cohort Study Team. Demographic and occupational predictors of early response to a mailed invitation to enroll in a longitudinal health study. *BMC Med Res Methodol*. 2007;7:6.

47. Smith B, Leard CA, Smith TC, Reed RJ, Ryan MA; Millennium Cohort Study Team. Anthrax vaccination in the Millennium Cohort: validation and measures of health. *Am J Prev Med*. 2007;32:347–353.

CLINICAL PERSPECTIVE

The present study evaluated the association of acutely stressful life experiences (military combat deployments and posttraumatic stress disorder) on coronary heart disease (CHD) among a young cohort of US service members (n=60 025) during the Iraq and Afghanistan conflicts. A total of 627 service members (1.0%) newly reported CHD during an average 5.6-year follow-up period. The experience of combat deployment was associated with increased odds of both self-reported new-onset CHD and having a medical diagnosis code for new-onset CHD in the records. Screening positive for posttraumatic stress disorder symptoms was associated with self-reported CHD before but not after adjustment for depression and anxiety. Posttraumatic stress disorder was not associated with a new diagnosis code for CHD; however, the sample for this analysis had limited power. The present study demonstrates that intense and acute stressful life experiences may increase the risk for CHD over a relatively short period among young adults.

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14. ABSTRACT

Background. The recent conflicts in Iraq and Afghanistan have exposed thousands of service members to intense stress, and as a result, many have developed posttraumatic stress disorder (PTSD). The role of military deployment experiences and PTSD in coronary heart disease (CHD) is not well defined, especially in young US service members with recent combat exposure.

Methods and Results. We conducted a prospective cohort study to investigate the relationships between wartime experiences, PTSD, and CHD. Current and former US military personnel from all service branches participating in the Millennium Cohort Study during 2001 to 2008 (n=60 025) were evaluated for newly self-reported CHD. Electronic medical record review for International Classification of Diseases, Ninth Revision, Clinical Modification codes for CHD was conducted among a subpopulation of active duty members (n=23794). Logistic regression models examined the associations between combat experiences and PTSD with CHD with adjustment for established CHD risk factors. A total of 627 participants (1.0%) newly reported CHD over an average of 5.6 years of follow-up. Deployers with combat experiences had an increased odds of newly reporting CHD (odds ratio, 1.63; 95% confidence interval, 1.11–2.40) and having a diagnosis code for new-onset CHD (odds ratio, 1.93; 95% confidence interval, 1.31–2.84) compared with noncombat deployers. Screening positive for PTSD symptoms was associated with self-reported CHD before but not after adjustment for depression and anxiety and was not associated with a new diagnosis code for CHD.

Conclusions. Combat deployments are associated with new-onset CHD among young US service members and veterans. Experiences of intense stress may increase the risk for CHD over a relatively short period among young adults.

15. SUBJECT TERMS
coronary disease, epidemiology, etiology, heart diseases, stress, military personnel

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